8.8 PALEONTOLOGICAL RESOURCES

Paleontological resources (fossils) are the remains or traces of prehistoric animals and plants. This section assesses the potential that earth-moving activities associated with construction of the proposed Pico Power Project (PPP) will impact scientifically important fossil remains. Section 8.8.1 discusses the existing environmental setting. Section 8.8.2 discusses the environmental effects of construction and subsequent operation. Section 8.8.3 evaluates any cumulative impacts to paleontological resources due to other simultaneous projects. Section 8.8.4 includes any proposed mitigation measures during construction and operation. Section 8.8.5 presents applicable laws, ordinances, regulations and standards (LORS). Section 8.8.6 references agency contacts. Section 8.8.7 presents permit requirements and schedules. Section 8.8.8 contains a list of references cited.

The analysis presented in this section meets all requirements of the California Energy Commission Appendix B Section (g)(16) and incorporates the Society of Vertebrate Paleontology (1995, 1996) standard measures for mitigating adverse construction-related environmental impacts on paleontological resources.

8.8.1 Affected Environment

8.8.1.1 Geographic Location and Physiographic Environment

The project area, including the PPP site and associated natural gas pipeline, are located at the northern end of the Santa Clara Valley at the south end of San Francisco Bay ("Bay"). The Bay fills a north-northwest-trending structural depression in the Coast Ranges Physiographic Province, in west-central California. The Santa Clara Valley is a southerly extension of this structural depression between the Diablo Range to the east and the Santa Cruz Mountains to the west.

The Santa Clara Valley consists chiefly of a number of confluent alluvial fans and floodplains formed by deposits from numerous streams that enter the valley from both mountain ranges. These valley sediments range from Late Quaternary to Holocene in age and include deposits from the Guadalupe River and Los Gatos Creek, levee deposits from the San Tomas Aquinas and Saratoga Creeks, and mud deposits from San Francisco Bay (Helley and Wesling 1989; Wesling and Helley 1989; Helley and Brabb 1971; Helley and LaJoie 1979). As these various streams enter the Bay, they transform into intertidal sloughs with adjacent marsh areas.

The project area is located entirely within Santa Clara County and primarily within the U.S. Geological Survey (USGS) Milpitas and San Jose West Quadrangles (1:24,000).

8.8.1.2 Regional Geologic Setting

Bedrock in the adjacent mountains ranges from Tertiary marine sedimentary rocks, Tertiary volcanic rocks, to Jurassic and Cretaceous Franciscan Assemblage (Bailey et al. 1964; Page 1966; Helley and Brabb 1971; Helley and LaJoie 1979; Wahrhaftig et al. 1993). The Franciscan Assemblage also forms the bedrock underlying the alluvium in the Santa Clara Valley. The PPP site is over five miles from bedrock outcrops in the adjacent mountain ranges. Additional information on the regional geologic setting is contained Section 8.4 (Geological Hazards and Resources).

The PPP site and its ancillary facilities are located on materials mapped as (Qhb) floodbasin deposits (Helley et al. 1994). Other workers have variously mapped the area as Qb (interfluvial basin deposits), Qhaf (fine-grained alluvium), Qhb (floodbasin deposits), or Q (alluvium), which all represent recent, Holocene-age alluvium (Helley and Brabb 1971; Wagner et al. 1991; Helley and Wesling 1989; Wesling

and Helley 1989; Helley and LaJoie 1979). These deposits are generally fine-grained, rich in organic matter, and overlie an older alluvial fan system composed of Pleistocene-age sediments.

Temescal Formation

Lawson (1914) mapped a complex of Quaternary formations along the eastern shore of San Francisco Bay including, from oldest to youngest, the Alameda Formation, San Antonio Formation, Merritt Sand, and Temescal Formation. Later geological mapping (i.e., Helley and Wesling 1989) depicted geological facies, mapping units which reflect depositional processes, rather than Lawson's named formations, which are lithologically and chronologically distinctive units. Many of the units mapped by more recent investigators are gradational, with alluvial fans grading westward to alluvial plains, which grade imperceptibly into Bay muds. These facies subdivisions make it difficult to compare descriptions of fossil sites, which typically refer to named stratigraphic units. In general, Lawson's Temescal Formation corresponds to younger Holocene-age alluvial and flood basin deposits. Well drilling logs indicate that alluvial deposits are at least 460 m thick beneath central San Jose (Poland undated, citing California Department of Water Resources 1967).

Santa Clara Formation

The Santa Clara Formation consists of poorly sorted conglomerate, sandstone, siltstone, and clay (Iwamura 1995; Poland undated, citing Dibblee 1966). According to Dibblee, the sediments composing the Santa Clara Formation were washed down from the mountainous area along the valley margins, and are deposited beneath the younger, unconsolidated alluvial fill in the basin. Iwamura (1995) noted that the subsurface boundary between the Santa Clara Formation and the younger alluvial fill could not be distinguished.

Franciscan Complex

Alluvium in the project area is underlain at depth by the Jurassic to Cretaceous-age sediments of the Franciscan Complex. This formation consists mainly of sandstone and shale (or mudstone), but contains lesser amounts of chert, serpentinite, and greenstone. The geology and paleontology of the Franciscan Complex has been described by various authors (Bailey et al. 1964; Wachs and Hein 1975; Murchey et al. 1983; Sliter and McGann 1992; Snetsinger 1976;Hagstrum and Murchey 1993).

Helley and LaJoie (1979) and Helley and Brabb (1971) have reported the presence of Holocene-age molluscan fossils and "modern fresh-water gastropods and pelecypods" from the younger Quaternary and Holocene deposits. Due to the proximity to the San Francisco Bay, the Guadalupe River, and San Tomas Aquinas Creek, the surface sediments at the site are likely very recent in age, i.e., deposited with the last several hundred to several thousand years. Due to the very recent age of such sediments, there is low potential for recovering vertebrate fossils from the Holocene alluvium of the site. Older alluvium (i.e., Temescal Formation) from various sites around the margin of San Francisco Bay has been known to contain Rancholabrean-age vertebrate fossils. PPP site construction excavations, if they were extended to depths of 12-15 feet, might encounter somewhat older Holocene-age paleontologic resources. The Santa Clara Formation has been known to yield Pliocene-age vertebrate fossils; however, since the Santa Clara Formation underlies the younger alluvium at depths of 150 to 1500 feet in the Santa Clara Valley (Iwamura 1995; Poland undated), the project site is not expected to encounter any materials associated with this formation. Fossil vertebrates from the Franciscan Complex are rare. Known invertebrate fauna from the Franciscan Complex consists of radiolaria and foraminifera from chert, sandstone, shale, and mudstone sediments (Brabb and Blondeau 1983; Sliter et al. 1993). The PPP site is not expected to encounter any materials associated with the bedrock Franciscan complex.

8.8.1.3 Paleontological Resource Inventory Methods

A stratigraphic inventory and paleontological resource inventory were completed to develop a baseline paleontological resource inventory of the project site and surrounding area by rock unit, and to assess the potential paleontological productivity of each rock unit. Research methods included a review of published and unpublished literature and a cursory field survey. These tasks complied with CEC (2000) and Society of Vertebrate Paleontology (1995) guidelines.

Stratigraphic Inventory

Geological maps and reports covering the geology of the project site and area were reviewed to determine the exposed rock units and to delineate their respective aerial distributions in the project area.

Paleontological Resource Inventory

Published and unpublished geological and paleontological literature were reviewed to document the number and locations of previously recorded fossil sites from rock units exposed in and near the project site and surrounding area and the types of fossil remains each rock unit has produced. The literature review was supplemented by an archival search conducted at the University of California Museum of Paleontology in Berkeley, California on June 21, 2002.

Field Survey

The field reconnaissance was conducted on May 10, 2002, to document the presence of any previously unrecorded fossil sites and of strata that might contain fossil remains. The field survey was conducted by Tom Stewart, Ph.D., a qualified paleontologist with several publications in refereed scientific journals addressing fossils and paleoenvironmental analysis. Reconnaissance was limited to inspection of the visible ground surface at the PPP site as well as the natural gas pipeline route. No exposures of potentially fossiliferous strata were observed in the PPP construction zone. A complete pedestrian survey of the entire project area of potential effect for paleontological resources was considered unnecessary and no subsurface exploration was conducted. A more detailed survey was considered unnecessary because the project site is located in a lowland, depositional environment consisting of the surface of very recent Holocene alluvium. Pleistocene deposit outcrops are unlikely in this area because of the lack of erosional features to expose older sediments beneath the Holocene sediments. In addition, much of the ground surface is obscured by the buildings and roads of this urbanized environment.

8.8.1.4 Paleontological Resource Assessment Criteria

The potential paleontological importance of the project area can be assessed by identifying the paleontological importance of exposed rock units within the project area. Since the aerial distribution of a rock unit can be easily delineated on a topographic map, this method is conducive to delineating parts of the project that are of higher and lower sensitivity for paleontological resources and to delineating parts of the project that may therefore require monitoring during construction.

A paleontologically important rock unit is one that: 1) has a high potential paleontological productivity rating, and 2) is known to have produced unique, scientifically important fossils. The potential paleontological productivity rating of a rock unit exposed at the project site refers to the abundance/densities of fossil specimens and/or previously recorded fossil sites in exposures of the unit in and near the project site. Exposures of a specific rock unit at the project site are most likely to yield fossil remains representing particular species in quantities or densities similar to those previously recorded from the unit in and near the project site. However, well-developed and documented fossil-bearing formations are unlikely to yield a unique paleontological resource.

An individual vertebrate fossil specimen may be considered unique or significant if it: 1) identifiable, 2) complete, 3) well preserved, 4) age diagnostic, 5) useful in paleoenvironmental reconstruction, 6) a type or topotypic specimen, 7) a member of a rare species, 8) a species that is part of a diverse assemblage, and/or 9) a skeletal element different from, or a specimen more complete than, those now available for its species. For example, identifiable vertebrate marine and terrestrial fossils are generally considered scientifically important because they are relatively rare. The value or importance of different fossil groups varies, depending on the age and depositional environment of the rock unit that contains the fossils, their rarity, the extent to which they have already been identified and documented, and the ability to recover similar materials under more controlled conditions such as part of a research project. Marine invertebrates are generally common, well developed, and well documented. They would generally not be considered a unique paleontological resource.

The following tasks were completed to establish the paleontological importance of each rock unit exposed at or near the project site:

- The potential paleontological productivity of each rock unit exposed at the project site was assessed, based on the density of fossil remains previously documented within the rock unit.
- The potential for a rock unit exposed at the project site to contain a unique paleontological resource was considered.

8.8.1.5 Resource Inventory Results

Stratigraphic Inventory

This section begins with an overview of the surficial geology of the project region and attempts to correlate the various geologic units. This is followed by a description of the geologic units that occur in the immediate project vicinity.

Regional surficial geologic mapping of the project site and vicinity (1:125,000 or 1:500,000 scale) is provided by Helley and Brabb (1971); Wagner et al. (1991); Helley and LaJoie (1979); and Wahrhaftig et al. (1993). Larger scale mapping of the project site (1:24,000 or 1:62,500 scale) is provided by Helley and Wesling (1989); Wesling and Helley (1989); and Helley and Brabb (1971).

Paleontological Resource Inventory and Assessment by Rock Unit

Mammalian fossils have been the most helpful in determining the relative age of alluvial fan sedimentary deposits (Louderback 1951; Savage 1951). The mammalian inhabitants of the late Pleistocene and Holocene alluvial fan and floodplain included horses, mastodons, camels, ground sloths, and pronghorns.

Surveys of Late Cenozoic land mammal fossils in the project region have been provided by Hay (1927), Stirton (1939), Savage (1951), and Jefferson (1991b). On the basis of his survey of vertebrate fauna from the non-marine Late Cenozoic deposits of the San Francisco Bay region, Savage (1951) concluded that only two divisions of Pleistocene time could be recognized in the San Francisco Bay region. He named the earlier Pleistocene fauna the Irvingtonian and the later Pleistocene and Holocene fauna the Rancholabrean. The age of the later Pleistocene, Rancholabrean fauna was based on the presence of bison and on the presence of many mammalian species which are inhabitants of the same area today. In addition to bison, larger land mammals identified as part of the Rancholabrean fauna include mammoths, mastodons, camels, horses, and ground sloths.

A vertebrate fossil site approximately 2.1 miles from the proposed project location has been recorded with the UC Berkeley Museum of Paleontology. This site contains a Rancholabrean-age bone fragment from a mammoth. Other Rancholabrean-age vertebrate fossils have been reported from the general vicinity of

the proposed PPP site and related facilities, and the project area may therefore be considered an area of potential sensitivity for paleontological resources. A table providing the details of fossil remains, and a map showing the locations of these fossil sites, are provided in Appendix 8.8-A (filed separately under a request for confidentiality).

Temescal Formation

Remains of land mammals have been found at a number of localities in younger alluvial deposits referable to the Temescal Formation (Hay 1927, Louderback 1951, Savage 1951, Jefferson 1991b). Jefferson (1991a,b) compiled a database of California Late Pleistocene (Rancholabrean North American Land Mammal Age) vertebrate fossils from published records, technical reports, unpublished manuscripts, information from colleagues, and inspection of museum paleontological collections at over 40 public and private institutions. He listed ten individual sites in Santa Clara County that have yielded Rancholabrean vertebrate fossils. These fossils would presumably all be referable to the Temescal Formation, as used in this AFC section.

The most common fossils reported from Rancholabrean-age alluvial sediments in the East Bay area are the remains of mammoths, bison, and horses. Helley and LaJoie (1979) noted that the flood basin deposits (likely a part of the Temescal Formation) locally also contain fresh water invertebrate fossils (gastropods and pelecypods). Helley and LaJoie (1979) also noted that alluvial deposits (also part of the Temescal Formation) locally contain aboriginal artifacts and skeletal remains. The age of these deposits apparently extends from latest Pleistocene to the Holocene. Lawson (1914) referred to the Temescal Formation as entirely Holocene in age, but Louderback (1951) believed that the bulk of this younger alluvium was Pleistocene in age. Based on the presence of fossil bison, Savage (1951) referred the younger alluvium to the Rancholabrean North American Land Mammal Age, which spans the boundary between Late Pleistocene and Early Holocene.

The closest vertebrate fossil to the PPP is UCMP vertebrate fossil locality V-91128, located near Interstate 101 in the community of Sunnyvale, approximately 2.1 miles west of the PPP site. This site yielded the shoulder blade of a mammoth—a Rancholabrean land mammal. Vertebrate fossils identified as Rancholabrean fauna from the (probable) Temescal formation equivalent, found within five to seven miles of the proposed project site, include UCMP localities V-91248, -4916, and -6534. These fossil sites yielded remains of a mammoth, bison, and *Desmostylus* sp. (a "sea cow"). Additional Rancholabrean fossils, including remains of a mastodon and a horse, were recovered from UCMP localities V-72003 (in the foothills east of Warm Springs) and V-3937 (along the shore of the Calaveras Reservoir).

Santa Clara Formation

Irvingtonian-age vertebrate fossils have been recovered from a site in the foothills east of San Jose (UCMP V5723) and a site in the foothills northeast of Milpitas (UCMP V5313). These fossils were recovered from outcrops of the Pliocene-age Santa Clara Formation. However, at the PPP site, the Santa Clara Formation is found at depths of 150 to 1500 feet (Iwamura 1995; Poland undated), and project construction or operation is therefore is not likely to encounter them.

Power Plant Site

The occurrence of previously recorded fossil sites near the project site suggests that there is a potential for uncovering additional similar fossil remains during earth-moving activities related to construction of those areas of the project underlain by sediments of the Temescal Formation.

8.8.2 Environmental Consequences

The potential environmental effects from construction and operation of the PPP on paleontological

resources are presented in the following subsections.

8.8.2.1 Significance Criteria

In its standard guidelines for assessment and mitigation of adverse impacts to paleontological resources, the SVP (1995) established three categories of sensitivity for paleontological resources: high, low, and undetermined. Areas where fossils have been previously found are considered to have a high sensitivity and a high potential to produce fossils. In areas of high sensitivity that are likely to yield unique paleontological resources, full-time monitoring is typically recommended during any project ground disturbance. Areas that are not sedimentary in origin and that have not been known to produce fossils in the past, typically are considered to have low sensitivity and monitoring is usually not needed during project construction. Areas that have not had any previous paleontological resource surveys or fossil finds are considered undetermined until surveys and mapping are done to determine their sensitivity. After reconnaissance surveys, observation of exposed cuts, and possibly sub-surface testing, a qualified paleontologist can determine whether the area should be categorized as having high, low, or undermined sensitivity. In keeping with the significance criteria of the SVP (1995), all vertebrate fossils are categorized as being of potential significant scientific value.

Appendix G of CEQA addresses significance criteria with respect to paleontological resources (Public Resources Code Sections 21000 et seq.). Appendix G(V)(c) asks if the project will "directly or indirectly destroy a unique paleontological resource or site or unique geologic feature."

8.8.2.2 Construction

This section presents the potential adverse impacts on the paleontological resources resulting from construction of each portion of the PPP.

Power Plant Site and Natural Gas Compressor Station

Potential impacts on paleontological resources resulting from construction of the proposed PPP generation plant can be divided into construction-related impacts and impacts related to plant operation. Construction-related impacts to paleontological resources primarily involve ground disturbance (excavations and drainage diversion measures).

The proposed PPP site is situated on Holocene-age alluvium. Because of the very recent age of such sediments, there is low potential for recovering significant vertebrate fossils from the site.

The planned site filling and grading is not expected to result in significant adverse impacts to unique paleontological resources, because the ground surface in this area has already been greatly disturbed by construction of the existing buildings, structures, and roads. The supporting facilities, such as temporary construction offices, laydown areas, and parking areas, are also not expected to have a significant adverse impact on resources, because they are located on ground previously disturbed and will not involve significant ground disturbance.

Foundation excavations for the power plant may extend to approximately 12 to 15 feet below the finished grade. These deep excavations at the power plant site may encounter older Holocene sediments. Thus, these deep excavations could cause impacts to paleontological resources. However, only vertebrate fossils would be considered potentially significant because of their general rarity. Non-vertebrate fossils would not be considered significant because large quantities of these fossils have already been identified, and because similar materials could be recovered by investigations anywhere along Santa Clara Valley.

Excavations for the gas compressor station are not expected to extend beyond a depth of six feet. Thus,

construction of the natural gas compressor station is not likely to encounter significant paleontological resources.

Natural Gas Pipeline and Metering Station

The proposed natural gas pipeline route runs within Lafayette Street in a developed area on previously disturbed ground. Pipeline excavation is expected to extend to a depth of six feet. Thus, construction of the natural gas pipeline is not likely to encounter significant paleontological resources (more likely beyond 7 feet).

Waste Water Discharge Pipeline

Pipeline excavation is expected to extend to a depth of six feet. Thus, construction of the waste water discharge pipeline is not likely to encounter significant paleontological resources.

8.8.2.3 Operation

Project operation will not cause additional ground disturbance, and therefore will not affect paleontological resources.

8.8.3 Cumulative Impacts

If paleontological resources were encountered during PPP-related ground disturbance, the potential cumulative effect on paleontological resources will be low, as long as the mitigation measures proposed in Section 8.8.4 are implemented to recover the resources. When properly implemented, these mitigation measures will effectively recover the scientific value of significant fossils encountered during PPP construction. Thus, the proposed PPP will not cause or contribute to significant cumulative impacts to paleontological resources.

8.8.4 Mitigation Measures

This section describes measures that Silicon Valley Power proposes to reduce or mitigate potential project-related adverse impacts to significant paleontological resources, should any such resources be discovered during construction.

- **Paleontological Mitigation Plan—**The paleontological resource mitigation program will include the preparation of a mitigation and monitoring plan for construction monitoring; emergency discovery procedures; sampling and data recovery, if needed; museum storage coordination for any specimen and data recovered; preconstruction coordination; and reporting.
- **Paleontological Monitoring**—Prior to construction, Silicon Valley Power will retain a qualified paleontologist to design and implement a mitigation program during project-related earth-moving activities for deep excavation at the power plant site, and for construction of the water and natural gas pipelines. The paleontologist will monitor earth-moving construction activities where this activity will disturb previously undisturbed sediment. Monitoring will not take place in areas where the ground has been previously disturbed, in areas underlain by artificial fill, or in areas where exposed sediment will be buried but not otherwise disturbed.
- **Construction Personnel Education—**Prior to the start of construction, construction personnel involved with earth-moving activities will be informed of the possibility of encountering fossils, how to identify fossils, and proper notification procedures. This worker training will be prepared and presented by a qualified paleontologist.

Implementation of these mitigation measures will reduce the potentially significant adverse environmental

impact of project earth-moving activities on paleontological resources to an insignificant level. These measures will allow for the recovery of fossil remains and associated specimen data and corresponding geologic and geographic site data that otherwise might have been destroyed by construction and unauthorized fossil collecting.

8.8.5 Laws, Ordinances, Regulations, and Standards (LORS)

Paleontological resources are classified as non-renewable scientific resources and are protected by several federal and state statutes, most notably by the 1906 Federal Antiquities Act and other subsequent federal legislation and policies and by the state of California's environmental regulations (CEQA, Section 15064.5). Professional standards for assessment and mitigation of adverse impacts on paleontological resources have been established for vertebrate fossils by the Society of Vertebrate Paleontology (1995, 1996). Design, construction, and operation of the PPP, including pipelines and ancillary facilities, will be conducted in accordance with all LORS applicable to paleontological resources. Federal and state LORS applicable to paleontological resources are summarized in Table 8.8-1 and discussed briefly below, along with SVP professional standards.

8.8.5.1 Federal LORS

Federal protection for significant paleontological resources will apply to the PPP if any construction or other related project impacts take place on federally owned or managed lands. Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (PL 59-209; 16 United States Code 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federal land. The project currently does not cross such lands. Federal requirements will apply if a Federal agency obtained ownership of project lands during the term of the project license.

Table 8.8-1. Applicable LORS regarding paleontological resources.

LORS	Applicability	AFC Reference	Project Conformity
Antiquities Act of 1906	Protects objects of antiquity from vandalism and unauthorized collecting on federal lands (currently no federal land)	Section 8.8.5	yes
CEQA, Appendix G	Fossil remains may be encountered by earth-moving activities	Section 8.8.4, Section 8.8.5	yes
Public Resources Code, Sections 5097.5/5097.9	Would apply only if some project land acquired by state (currently no state land)	Section 8.8.5	yes

8.8.5.2 State LORS

The CEC environmental review process under the Warren-Alquist Act is considered functionally equivalent to that of CEQA (Public Resources Code Sections 15000 et seq.) with respect to paleontological resources. CEQA's Appendix G (Public Resources Code Sections 21000 et seq.) lists among its significant effects when a project will "disrupt or adversely affect...a paleontological site except as part of a scientific study."

Other state requirements for paleontological resource management are in Public Resources Code Chapter 1.7, Section 5097.5, *Archaeological, Paleontological, and Historical Sites*. This statute specifies that state agencies may undertake surveys, excavations, or other operations as necessary on state lands to

preserve or record paleontological resources. It would apply to the PPP only if the state or a state agency were to obtain ownership of project lands during the term of the project license.

8.8.5.3 County LORS

Santa Clara County does not have mitigation requirements that specifically address potential adverse impacts to paleontological resources.

8.8.5.4 Professional Standards

The Society of Vertebrate Paleontology (1995, 1996), a national scientific organization of professional vertebrate paleontologists, has established standard guidelines that outline acceptable professional practices in the conduct of paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, specimen preparation, analysis, and curation. Most practicing professional paleontologists in the nation adhere to the Society of Vertebrate Paleontology assessment, mitigation, and monitoring requirements, as specifically spelled out in its standard guidelines.

8.8.6 Involved Agencies and Agency Contacts

The lead agency for the protection of paleontological resources for this project will be the lead agency under CEQA, which in this case is the CEC. The CEC will designate a staff lead for paleontology when Silicon Valley Power files this application.

8.8.7 Permits Required and Permit Schedule

No state or county agency requires a paleontological collecting permit to recover fossil remains discovered by construction-related earth moving on either state or private land in the project site. However, if a Federal agency were to own or manage property occupied by project elements, a Bureau of Land Management Consultation Services Permit, issued under the Federal Antiquities Act and the Federal Land Management Policy Act, would be required. Up to two months could be required for the permitting process.

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